TITLE OF THE INVENTION

PROCESS FOR DISPERSING A FIBROUS PAPER STOCK AND DEVICE FOR PERFORMING THE PROCESS

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CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] The present application claims priority under 35 U.S.C. § 119 of German Patent Application No. 100 18 262.3, filed on April 13, 2000, the disclosure of which is expressly incorporated by reference herein in its entirety.

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0002] The invention relates to a process and device for dispersing fibrous paper stock. The preocess includes providing an aqueous fibrous paper stock, pressing out some of the water to form a highly consistent coarse fibrous paper stock, transporting the highly consistent coarse fibrous paper stock into a dispersing machine, and dispersing with a dispersing machine. The dispersing machine includes at least two dispersing fittings (tools, elements), which have several interlocking lines of teeth and are movable relative to one another at a distance so as to disperse the highly consistent fibrous paper stock.

2. Discussion of Background Information

[0002] Processes of the above-mentioned type are used, for instance, for improving the quality of fibrous stock made from recycled paper. It is known that fibrous paper stock can be homogenized by dispersion and, thus, be considerably improved. For this purpose, a highly consistent fibrous stock is produced having a dry content ranging from about 15 to 35%. In many cases, dispersion occurs at a temperature far exceeding the ambient temperature. Dispersion armaments used for such processes are compact and their dispersion effectiveness is excellent. However, they rely on an even stock flow. Since the duration in which the stock remains between them is very short, irregularities cannot be compensated. Thus,

inhomogeneous dispersing would result.

[0003] In the thickening process performed, a considerable part of the previously present water content in the fibrous stock is pressed out, because of which, its viscosity in dispersion is considerably increased and, if necessary, less water needs to be heated. Worm extruders are particularly economical machines for thickening. In a worm extruder, the fibrous stock suspension is pressed out between a conveyer screw and a perforated jacket surrounding it, with the water exiting through the perforations of the jacket. The pressed article or plug developed here is pushed out of the screw and breaks into pieces. The pieces are comparatively large and thus lead to an uneven stock flow through the subsequent devices.

[0004] A dispersion device is known from DE 197 12 653 A1 into which the plug from the worm extruder is directly introduced. Here, it is ground by a grinding tools using scrapers or knives which are positioned in the feeder of the dispersing device.

SUMMARY OF THE INVENTION

[0005] The present invention provides a device capable of feeding the highly consistent plug originating from the worm extruder into the dispersing process such that a particularly even dispersing is ensured at high operating security.

[0006] Accordingly, the process of the present invention includes, prior to dispersing, introducing the highly consistent coarse fibrous stock into an effective area of a rotating mallet roll having circulating mallets which cooperate with fixed peripheral impact sections to loosen and distribute the highly consistent fibrous stock.

[0007] With the aid of this new process, it is possible to produce a highly consistent stock that can be perfectly processed in a dispersing machine. The beetle roller used according to the invention accepts the plug pieces compressed by the water being pressing out and breaks them up, in particular, by cooperation of the circulating

beetles with the impact sections fixed to the circumference. Bigger chunks remain in the processing area longer until they can pass so that the stock flow to the dispersing machine becomes very even. Then, it is further reduced and swirled in the radially interior area of the dispersing armaments, creating very fine fibrous crumbs. If desired, steam is introduced subsequently downstream into a heating zone of the armaments in order to heat the stock to the required temperature. Here, due to the previous breaking up, a comparatively short heating duration is sufficient. The dispersing itself, i.e., the modification of the stock characteristics occurs in a dispersing zone of the device that follows downstream.

[0008] The present invention is directed to a process for dispersing fibrous paper stock that includes delivering an aqueous fibrous paper stock, pressing some water out of the aqueous fibrous paper stock to form a highly consistent coarse fibrous paper stock, and introducing the highly consistent coarse fibrous stock into an effective area of a mallet roll having circulating mallets which cooperate with fixed peripheral impact sections. In this manner, the highly consistent coarse fibrous stock is loosened and distributed. The process also includes transporting the highly consistent fibrous paper stock into a dispersing machine, and dispersing the highly consistent fibrous paper stock in a dispersing machine.

[0009] In accordance with a feature of the instant invention, the dispersing machine may include at least two dispersing fittings with several lines of teeth. The at least two dispersing fittings can be arranged so that the several lines of teeth are intermeshed and spaced at a distance from each other, and the process can further include rotating the at least two dispersing fittings relative to each other. The process can also include introducing water steam into the highly consistent fibrous stock while it is located between the dispersing fittings, whereby the highly consistent fibrous stock is heated. Moreover, the dispersing fittings can include a primary dispersing

area and a ring shaped heating zone arranged radially inside of the primary dispersing area, and the process can include introducing the water steam into the ring shaped heating zone.

[0010] According to another feature of the invention, the mallet roll can be essentially horizontally positioned, and the process may further include introducing the fibrous stock into the effective area of the mallet roll from above.

[0011] A worm extruder can assist in the pressing of water out of the aqueous fibrous paper stock. Further, a transport direction in the worm extruder can be essentially horizontal and an axis of the mallet roll may be essentially horizontal and substantially perpendicular to the worm extruder transport direction.

[0012] The process may further include rotating the mallets at a circumferential speed in a range between about 1 to 5 m/s, and can also include rotating the mallets at a circumferential speed of between about 2 and 4 m/s.

[0013] Further, the process can include calibrating the highly consistent fibrous stock between impact sections positioned at a distance from each other, as well as adjusting a maximum amount of calibrated fibrous stock pieces in the longitudinal direction to a size in a range between about 5 to 50 mm.

[0014] According to still another feature of the instant invention, the process includes transferring a specific work amount of less than about 1kWh/t from the mallet roll to the fibrous stock.

[0015] The process also includes dropping the fibrous stock, after passing the mallet roll, into a screw conveyor, and centrally introducing the dropped fibrous stock into the dispersing machine via the screw conveyor.

[0016] In accordance with a further feature of the present invention, the process includes heating the highly consistent fibrous stock while it is located between the dispersing fittings. Moreover, the process may include introducing water steam

between the dispersing fittings and into the highly consistent fibrous stock. The dispersing fittings may include a primary dispersing area and a ring shaped heating zone arranged radially inside of the primary dispersing area, and the process can also include introducing the water steam into the ring shaped heating zone to heat the highly consistent fibrous stock.

[0017] The present invention is directed to an apparatus for performing a process for dispersing fibrous paper stock. The apparatus can include a worm extruder structured and arranged to create a highly consistent coarse fibrous paper stock, and a distribution device arranged downstream from the worm extruder, relative to a stock transport direction, and a dispersing machine. The distribution device includes at least one rotating mallet roll including a plurality of essentially radially extending mallets, a housing, and a plurality of impact sections arranged to extend essentially radially inwardly from an interior wall of the housing.

[0018] According to a feature of the invention, the plurality of mallets and the plurality of impact sections can be axially spaced from each other.

[0019] Further, the mallet roll may be essentially horizontally arranged.

[0020] In accordance with another feature of the instant invention, an outermost diameter of the mallets may be in a range of between about 200 - 1000 mm.

[0021] According to still another feature of the invention, the impact sections may have staff shapes. Additionally, or alternatively, the impact sections may have plate shapes.

[0022] An axial distance between neighboring impact sections may be in a range between about 10 and 100 mm. Further, an axial distance between the mallets and the impact sections can be in a range between about 5 to 50 mm.

[0023] Moreover, a length of the mallet roll, within a tolerance of about ± 20 %, may be equivalent to an outer diameter of a press screw of the worm extruder.

[0024] In accordance with yet another feature of the instant invention, the dispersing machine may include at least two dispersing fittings with several lines of teeth mounted for rotation relative to each other, and the at least two dispersing fittings can be arranged so that the several lines of teeth are intermeshed and spaced at a distance from each other. Further, a steam introducing element may be arranged to introduce water steam into the highly consistent fibrous stock while it is located between the dispersing fittings. Moreover, the dispersing fittings can include a primary dispersing area and a ring shaped heating zone arranged radially inside of the primary dispersing area, and a steam introducing element can be arranged to introduce water steam into the ring shaped heating zone.

[0025] Other exemplary embodiments and advantages of the present invention may be ascertained by reviewing the present disclosure and the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWINGS

[0026] The present invention is further described in the detailed description which follows, in reference to the noted plurality of drawings by way of non-limiting examples of exemplary embodiments of the present invention, in which like reference numerals represent similar parts throughout the several views of the drawings, and wherein:

[0027] Figure 1 schematically illustrates a device for performing the process according to the present invention;

[0028] Figure 2 illustrates an alternative device which is similar to that depicted in Figure 1; and

[0029] Figure 3 schematically illustrates a distribution device according to the instant invention.

DETAILED DESCRIPTION OF THE PRESENT INVENTION

[0030] The particulars shown herein are by way of example and for purposes of illustrative discussion of the embodiments of the present invention only and are presented in the cause of providing what is believed to be the most useful and readily understood description of the principles and conceptual aspects of the present invention. In this regard, no attempt is made to show structural details of the present invention in more detail than is necessary for the fundamental understanding of the present invention, the description taken with the drawings making apparent to those skilled in the art how the several forms of the present invention may be embodied in practice.

[0031] Figure 1 shows details of a device that is particularly well suited for performing the process according to the invention. In the upper part of the drawing, a worm extruder 8 is discernible in which a large portion of water W is expressed from aqueous fibrous paper stock S1. In this manner, a compacted, highly consistent fibrous stock S2 is produced, which breaks off in large chunks at the end of the press section and drops through a short shaft 10 into a distribution device 9 positioned below. This contains as an essential component a mallet (hammer) roll 1 with moving mallets (hammers) 2 mounted in a circulating manner. Mallet roll 1 cooperates with impact sections 3 mounted in a fixed manner at the periphery, i.e., the housing of distribution device 9, so that the above-described effect can occur. Such impact sections can be embodied in the form of radially oriented staffs, as depicted here or, e.g., cubic or plate-shaped as well. After treatment, a highly consistent fibrous stock S3 moves through a drop funnel 11 to a screw conveyer 7 installed immediately in front of dispersing machine 4. Screw conveyer 7 drives fibrous stock S3 into a central area of dispersing machine 4 so that it arrives between dispersing fittings 5 and 6 and is dispersed. Dispersing fittings 5 and 6 include concentric lines of axially

interlocking teeth which are spaced a small distance from each other and are arranged to move past one another. However, the rotor and the stator are not pressed against each other. Such dispersing fittings are particularly effective, but require as even a stock flow as possible for an even dispersion.

[0032] It may be preferred to raise the temperature of the stock to be dispersed to a higher temperature via a steam introduction 12. With the aid of steam introduction 12, hot water steam D is introduced into a space between dispersing fittings 5 and 6, and preferably into a ring-shaped heating zone 13 positioned radially inside a primary dispersing area 14 of dispersing fittings 5 and 6. In primary dispersing area 14, the interlocking lines of teeth operate such that the highly consistent fibrous paper stock is dispersed in a manner that is known per se. Subsequently, dispersed fibrous paper stock S4 exits dispersing machine 4 through an opening in the bottom.

[0033] Figure 2 depicts an arrangement of devices used for performing the process in a different view, i.e., seen in the direction toward dispersing machine 4. By using distribution device 9 designed in accordance with the features of the instant invention, not only is an optimal distribution of stock produced by worm extruder 8 achieved, but also the advantage of a space-saving arrangement. In the industrial use of the process, a relatively large diameter must be selected for the shaft of worm extruder 8 due to the relatively large amounts of stock. The fibrous stock produced at the end of worm extruder 8 cannot flow and, therefore, an arrangement should be made so that it can essentially fall freely straight downward. The position of distribution device 9 in the manner shown allows to intercept the fibrous stock produced over the entire length of worm extruder 8 and to guide it off into drop shaft 10 positioned below after appropriate treatment. Therefore, it is advantageous to position mallet roll 1 perpendicular to a main transport direction of worm extruder 8.

This unit, i.e., worm extruder 8 and distribution device 9, can be advantageously positioned in relation to dispersing machine 4 depending on the availability of space.

[0034] The basic design of distribution device 9 with mallet roll 1 is shown in Figure 3. Mallet roll 1 with a length L contains a number of mallets 2 whose outer ends rotate in a circle having a diameter D. They cooperate with impact sections 3 mounted to housing 15 of this device. This achieves the fact that the incoming coarse fibrous paper stock is first broken up. The breaking up occurs with a relatively small amount of force which can be explained in that the fibrous paper stock produced here is only compressed and merely this compression needs to be loosened. This is not to be compared, e.g., with recycled paper present in moist webs such as the one processed in, e.g., pulpers. Advantageously, the distances a between axially neighboring fixed impact sections 3 are chosen such that highly consistent fibrous stock S2 is calibrated in between, i.e., the passing of stock chunks that are not been sufficiently broken up is prevented. The particles passing in the longitudinal direction have a defined maximum size of, e.g., about 30 mm. Accordingly, the distance a could be determined by a simple experiment. It could also be advantageous to design it in a variable fashion in order to adjust the machine to different requirements. An axial distance b between contacting mallets 2 and impact sections 3 has a strong influence on the breaking up effect of this device as well. It is advantageously between about 5 and 20 mm.

[0035] The shape of mallets 2 or of impact sections 3 is to be determined in accordance with the purpose. Here, rather simple shapes are depicted only to demonstrate the function. They can, e.g., be in an arched shape or, viewed in the circumferential direction, diagonally positioned as well. It is also conceivable to provide them with wear-resistant coatings in order to extend their life span.

[0036] It is noted that the foregoing examples have been provided merely for

the purpose of explanation and are in no way to be construed as limiting of the present invention. While the present invention has been described with reference to an exemplary embodiment, it is understood that the words which have been used herein are words of description and illustration, rather than words of limitation. Changes may be made, within the purview of the appended claims, as presently stated and as amended, without departing from the scope and spirit of the present invention in its aspects. Although the present invention has been described herein with reference to particular means, materials and embodiments, the present invention is not intended to be limited to the particulars disclosed herein; rather, the present invention extends to all functionally equivalent structures, methods and uses, such as are within the scope of the appended claims.